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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. 0635MH-40860

In re Application of:

FREDERICK S.M. HERZ, ET AL.

Serial No. **TO BE ASSIGNED**

Filed: **HEREWITH**

For: **SYSTEM FOR COLLECTING,
ANALYZING, AND TRANSMITTING
INFORMATION RELEVANT TO
TRANSPORTATION NETWORKS**

TRANSMITTAL

Assistant Commissioner for Patents
Washington, D.C.

Sir:

Enclosed for filing please find:

1. This Transmittal with Certificate of Express Mail;
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3. Declaration;
4. Assertion of Entitlement to Small Entity Status;
5. Power of Attorney;
6. Our check in the amount of \$355.00;
7. Our return postcard which we would appreciate you date stamping and returning to us.

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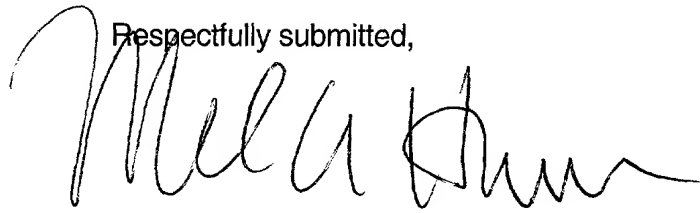
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No other fee is deemed necessary, however, the undersigned hereby authorizes the Commissioner to charge any additional fees, or credit any overpayments, to Deposit Account No. 50-1060.

Respectfully submitted,



Melvin A. Hunn
Reg. No. 32,574
HILL & HUNN, LLP
201 Main Street, Suite 1440
Fort Worth, Texas 76102
(817) 332-2113 (voice)
(817) 332-2114 (facsimile)
melhunn@hillandhunn.com (e-mail)

ATTORNEY FOR APPLICANT

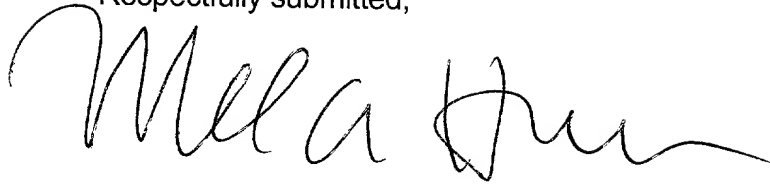
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For: **SYSTEM FOR COLLECTING,
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INFORMATION RELEVANT TO
TRANSPORTATION NETWORKS**

16 OCT 68

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Melvin A. Hunn". The signature is fluid and cursive, with a long horizontal stroke at the end.

Melvin A. Hunn

Reg. No. 32,574

HILL & HUNN, LLP

201 Main Street, Suite 1440

Fort Worth, Texas 76102

(817) 332-2113 (voice)

(817) 332-2114 (facsimile)

melhunn@hillandhunn.com (e-mail)

ATTORNEY FOR APPLICANT

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SPECIFICATION

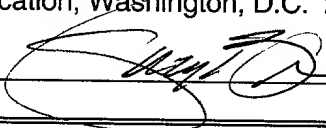
Attorney Docket No. **0635MH-40860**

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that we, **Frederick M.S. Herz**, a U.S. citizen, residing in the city of Warrington, Pennsylvania; **Pierre Lemaire**, a U.S. citizen, residing in the city of Philadelphia, Pennsylvania; **Jean H. Lemaire**, a Belgian citizen, residing in the city of Marlton, New Jersey; and **Paul Labys**, a U.S. citizen, residing in the city of Carrboro, North Carolina, have invented new and useful improvements in a

SYSTEM FOR COLLECTING, ANALYZING, AND TRANSMITTING INFORMATION RELEVANT TO TRANSPORTATION NETWORKS

of which the following is a specification:

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This Application claims the benefit of U.S. Provisional Patent Application No. 60/159,772, filed 15 October 1999, titled "System for Collecting, Analyzing and Transmitting Information Relevant to Transportation Networks."

BACKGROUND OF THE INVENTION

When individual persons or vehicles move through a transportation network, they are likely to be both actively and passively creating information that reflects their location and current behavior. In this patent, we propose a system that makes complete use of this information. First, through a broad web of sensors, our system collects and stores the full range of information generated by travelers. Next, through the use of previously-stored data and active computational analysis, our system deduces the identity of individual travelers. Finally, using advanced data-mining technology, our system selects useful information and transmits it back to the individual, as well as to third-party users; in short, it forms the backbone for a variety of useful location-related end-user applications.

SUMMARY OF THE INVENTION

1 It is our contention that such information is even more
2 valuable when it is gathered and stored centrally. This allows for the application
3 of advanced data analysis techniques that can detect patterns and form
4 connections across the data sets, which may be of great value both to the
5 original traveler as well as to interested third parties. For example, it may be
6 that the congestion of the harbor (i.e. ship traffic) has a significant impact on the
7 travel times of the commuter boat. Our system would detect this connection by
8 correlating the ferry's arrival and departure times with the harbor radar data.
9 Using this information, a real-time navigational application could then allow the
10 ferry operator to make precise predictions for the estimated time of arrival, given
11 the current state of the harbor traffic.

12
13 As outlined in a previous patent, LEIA (Location Enhanced Information
14 Architecture) provides a framework for the collection, analysis, and
15 retransmission of relevant data. This is a very general architecture which can be
16 broken down into the following steps (Figure 1 provides a schematic of this
17 process):

18
19 1. Sensors acquire signals from an individual user

20 These signals include everything that can be used to identify and
21 geographically locate an individual, be they from Active Badges, cellular
22 phones, motion detectors, EZ-Pass toll-booth devices, interactions with a

individual user's profile, other users' profiles, and background information relevant to the domain (e.g. weather or traffic conditions in the locale of the user).

6. Most Relevant Information Set Delivered to Individual or Third-party User.

We adapt this general architecture to be of particular use to travelers (be they people or vehicles) involved with transportation systems (road, air, sea, or intermodal), and refer to it as LEIA-TR (for LEIA applied to TRansport).

What follows is a detailed description of how this adaptation is accomplished, using the particular example of automobiles. Although specific types of sensors and end-user applications are mentioned, these can always be enhanced, added-to, or replaced. The importance of the description is in showing how LEIA can be used as a general data-collection and analysis architecture relevant to transport systems.

BRIEF DESCRIPTION OF THE DRAWINGS

1 The novel features believed characteristic of the invention are set forth in the
2 appended claims. The invention itself however, as well as a preferred mode of use,
3 further objects and advantages thereof, will best be understood by reference to the
4 following detailed description of an illustrative embodiment when read in
5 conjunction with the accompanying drawings, wherein:

6 Figure 1 is a schematic of the Location Enhancement Information
7 Architecture;

8 Figure 2 is a simplified schematic description of the use of the LEIA system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 2 gives a simplified schematic of the description that follows (and doesn't include all the details given in the description).

As applied to automobiles, LEIA-TR would adapt to the generalized LEIA framework in the following way:

1. Sensors acquire signals (generated actively and passively, both internal and external to vehicle)

- * Global Positioning Satellite (GPS) receiver

- * Vehicles' current speed and directional acceleration

- * Automated recognition of license-plate tags by roadside cameras

- * EZ-Pass use at toll booths

- * Vehicles' biometrics sensors

- * Lo-Jack transmissions (normally used as locational beacon in case of car theft)

- * Particular settings of car's rear-view mirror, seat belt lengths, seat positions.

- * Logs and content pertaining to:

 - e-mail

 - telephone calls

 - web browsing

 - personal calendar agents

1 (These are communications generated either in-vehicle, or at home
2 before trip)

3 * Current traffic patterns

4 * Day-of-year, day-of-week, current time and current weather.

5 * Credit card, ATM, or public telephone transactions.

6
7 2. Sensors Emit Location Identifiers (LID)

8
9 LEIA-TR lies at the center of a web of sensors; when any of these are
10 triggered by a traveler's passage, they transmit the information they've gathered
11 to a central server. These transmissions, which are sent using a standard
12 protocol, are termed Location Identifiers (LIDs).

13 It also is important to note that many of the sensors, such as those
14 detecting biometrics, GPS coordinates, and vehicle driving behavior (e.g.
15 pressure on the pedals, speed of turns, etc.), are located in the car itself, which
16 transmits LIDs to a central server using wireless communication technology (e.g.,
17 the Iridium satellite telephone). When a GPS receiver is installed in a vehicle, the
18 geographical coordinates can be transmitted in conjunction with the LID's,
19 thereby giving LEIA-TR a very accurate real-time estimate of the vehicle's
20 location.

21
22 3. Secure System Uses LIDs to Deduce User Identifiers (UID)

1 Although the specific identity of an individual driver might not be known,
2 LEIA-TR can make use of the available signals, as well as a database linked to
3 the vehicle, to deduce the identity of the individual behind the wheel (whether it
4 be the person's true identity or simply a pseudonym, depending on security
5 settings). This non-parametric process is described in detail below.

7 **Note on Computational Strategies**

8
9 Although it is possible to naively dump all available sensor inputs into a
10 computational "black box", the high dimensionality of the input space can
11 potentially render even the largest data set sparse, reducing the effectiveness of
12 LEIA-TR's inferences. A better strategy is to determine which inputs have the
13 greatest effect on different outputs, constructing appropriate statistical inferences
14 for each set.

15
16 There are, of course, a multitude of non-parametric techniques that can be
17 used for classification; the power of a particular technique (be it nearest neighbor
18 or a neural network) often depends on the particular nature of the data being
19 examined. The following discussion will outline general computational
20 approaches, but it should be understood that the particular algorithms used to
21 implement them are fairly interchangeable, and might well depend on the
22 particular nature of the data examined. For sets of data that happen to be

1 particularly complex (i.e. nonlinear), it may be necessary for a data analyst to
2 identify and focus on the most relevant subsets of the data.

4 **Inferring the Identity of the Driver**

6 A certain subset of the input data I , call it I_D , will be most useful for
7 establishing the identity of a vehicle's driver (and perhaps other passengers), D_i
8 (where i indexes the licensed drivers in the family). This should be fairly straight-
9 forward to establish; indeed, many luxury cars today have keys that allow them to
10 distinguish individual drivers, automatically reconfiguring such details as the
11 angle of the seat and tilt of the rearview mirror upon insertion of the key. Of
12 course, this data could be supplemented by biometric readings (fingerprints,
13 voiceprints) and physical behavior of the driver (foot pedal pressure, average
14 speed, and the sharpness of turns). If this information were to be linked to the
15 vehicle's wireless LID transmissions, LEIA-TR would have little trouble
16 distinguishing drivers.

17 Because such data should give a fairly unambiguous signal about the
18 identity of the driver, the classification problem is straight-forward and could be
19 economically handled by a rule-base, which slices the input space into fairly
20 broad regions that correspond to different categories. An example of such a rule
21 would be:

1 Given two drivers in the family {D₁= 90-year-old grandmother, D₂= 17-year-old
2 male},

3
4 Rule X. IF [(Speed>40 mph) AND (Radio_Music_Genre==Rock)] THEN (Driver
5 = D₂)

6
7 There are numerous ways to perform the induction of such rules, for
8 example by genetic programming or by estimating a non-parametric regression
9 tree, both of which are well-understood and documented in the literature.

10
11 The resulting rule base can be thought of as a function $r: I_D \rightarrow D$.

12
13 4. UIDs used to access personal profile data.

14
15 Having derived a pseudonymous UID for the individual behind the wheel
16 of the vehicle, LEIA-TR connects to a proxy server containing:

17
18 * Database of individuals' past driving behavior (destinations, cruising
19 speeds, etc.).

20 * Database of individuals' demographic profiles

21 * Database of individuals' past selection of information content (i.e., what
22 radio stations did they listen to en-route?)

23 * Computerized road maps

1
2 (5,6) Most appropriate set of information chosen and delivered to driver or to
3 third-party user.
4

5 In the final stages, information is processed and delivered, as defined by
6 the application for which LEIA-TR has been configured. Sample applications,
7 and users of interest, are listed below.
8

9 ***Application A: Personalized Information Delivery, for Driver (or Passengers) of Automobile***
10

11 Equipped with the proper sensors, given access to certain databases, and
12 loaded with appropriate algorithms, LEIA-TR forms the foundation for an
13 intelligent system capable of inferring drivers' identities, predicting their future
14 locations, and predicting the content of the information they'd like delivered to
15 their in-car computers/viewing/listening systems. In short, LEIA-TR can be used
16 as a wireless automotive "push" technology.
17

18 For example, one could imagine a commuter in California who on his way
19 to work would like to get the latest stock quotes on Microsoft, check his office
20 voicemail, and hear the news from Germany, interspersed with local traffic
21 reports. Although no radio station might provide this particular combination of
22 programming, it could easily be supported by LEIA-TR. Linked to the user's car
23 via a wireless connection, LEIA-TR would either be handed the driver's identity
24 code (signaled by the car itself), or use the driver's behavior, biometrics, and EZ-

ABSTRACT

When individual persons or vehicles move through a transportation network, they are likely to be both actively and passively creating information that reflects their location and current behavior. In this patent, we propose a system that makes complete use of this information. First, through a broad web of sensors, our system collects and stores the full range of information generated by travelers. Next, through the use of previously-stored data and active computational analysis, our system deduces the identity of individual travelers. Finally, using advanced data-mining technology, our system selects useful information and transmits it back to the individual, as well as to third-party users; in short, it forms the backbone for a variety of useful location-related end-user applications.

1 Pass code to infer it. Taking into account the driver's past trips, personal
2 calendar agent, date and time of day, LEIA-TR could predict the route that he will
3 follow. Using information on current traffic patterns (as well as knowledge of the
4 driver's preferred driving speed), LEIA-TR could estimate when the driver would
5 be closest to various transmitting servers along his route. These would be
6 loaded (pre-cached) with appropriate chunks of programming and traffic reports
7 so that the driver will be provided with a constant stream of data as he goes to
8 work. Economies of scale would also come into play; determining that many
9 drivers are interested in the day's weather report, for example, LEIA-TR could
10 load the report into a few servers in proximity to the most heavily-traveled traffic
11 arteries. Each driver's programming would then be arranged so that the weather
12 report would be loaded as they pass one of these central servers. Such
13 coordination would require massive amounts of computation, but would be quite
14 feasible using modern statistical techniques, and would certainly maximize the
15 effectiveness of LEIA-TR's pre-caching technology.

16
17 Of course, pre-cached data need not pertain exclusively to public
18 information streams. If a passenger is accessing the Web, email, or voice mail,
19 pertinent files can be transferred from remote file caches (e.g. those on his
20 personal computer at home) to nearby servers.

1 **Inferring Location, Current and Future**

2 Once the driver's identity has been inferred, LEIA-TR needs to be able to
3 1) predict current (if GPS LIDs are not available) and future location of the
4 automobile, and 2) predict the driver's information needs. It is a much more
5 challenging task to infer the current (and to predict the future) location of the
6 vehicle, since it is not being constantly monitored: we might glimpse it at a toll-
7 both as its EZ-Pass registers, or we might be handed a GPS code when the
8 driver requests a digital road map. LEIA-TR must infer, from these irregular
9 samples, the route of the vehicle. The appropriate portion of the input space, I_L ,
10 would include samples of communications, map data, GPS signals, EZ-Pass
11 signals, Lo-Jack signals, automated license-tag readers, time and date stamp,
12 weather conditions, and traffic conditions.

13 As disclosed in co-pending patent application entitled "Location Enhanced
14 Information Architecture", the location information may be inferred from the
15 relative signal strengths of a probable user's roaming signal as detected by two
16 or more nearby cellular transmitter/receiver towers.

17
18 LEIA-TR also has access to a database containing past routes and
19 conditions for driver D. Since the vehicle would have been observed at different
20 times and at different locations, the raw database might well be "patchy", in that
21 some trips might only have a few location data points. One way to normalize this
22 data would be the following: Assume that the car sends a signal to LEIA-TR both
23 upon ignition and upon being shut off. Every trip would then consist of L_0

1 (location when started), L_T (location when parked), and most likely a series of L_t
2 (where for time t , $0 < t < T$). Using this information and a digital road map, LEIA-
3 TR could then infer the full route followed. For example, if the starting location
4 point was at the home, the ending point was at the office, and three locational
5 signals fell on a superhighway, one could infer that the full route took the vehicle
6 from the home to the on-ramp, along the highway to the off-ramp, then to the
7 office. Having reconstructed the full path of each of these routes, it would then
8 be possible to sample them at regular intervals, so that every trip in the database
9 would be described by points on the same grid. In addition to standardizing the
10 way we describe paths, this approach fills in the gaps for trips in which very few
11 location readings were taken. Note that the grid can be defined by a distance
12 (such as a half-mile interval), or more usefully, the position of transmitters that
13 serve out information to passing cars. These gridded locations along a route can
14 be thought as checkpoints.

15
16 Even after the location-points are standardized, this route history database
17 will be extremely large, since it will contain a detailed record of every trip made
18 by the car: the driver's identity, passengers' identities, various state variables
19 (weather, time, driving patterns), and geographical paths driven. Some effort
20 needs to be made to reduce the input space's dimensionality; this could be done
21 through such methods as Principal Component Analysis, which could determine
22 (for a commuter, e.g.) that the day-of-week and time-of-day are the most
23 important variables needed for characterizing different routes taken by the car.

1
2 The raw route data is thus boiled down into a final, more compact, format.
3 An entry in LEIA-TR's database would then be of the form: { current_state (time,
4 date, weather, etc. in compact form), L_0 (starting location), ... , L_n (nth location),
5 ..., L_T (final location) }.

6
7 In regular operation, LEIA-TR will maintain a similar vector, y , for the
8 current trip: the state is boiled down to the compact form (for example, casting
9 9:15am --> Morning), and the previous location checkpoints are recorded.

10
11 At this point, there are a variety of standard nonparametric methods that
12 can be brought to bear. Given the current state y of the automobile (occupants,
13 time of day, day of week, etc.), and given the database of past routes taken by
14 this automobile, which can be correlated with the former, it is possible to assign
15 probabilities to the possible destinations for the current route being taken.

16
17 Note that many complexities can be added to this analysis. Using similar
18 methods, we could, for example, generate a conditional probability $P(L_{t+n} \mid I_t, D,$
19 $y)$ for the n th future checkpoint location (where I_t represents the state information
20 at time t). Thus, as the current trip's state vector y is updated, each checkpoint in
21 the surrounding area can be assigned a probability that it will be passed by the
22 target vehicle. LEIA-TR might then pre-cache data in those several locations
23 with the highest probabilities.

1
2 By noting both the current traffic conditions, projected route, and D's
3 average driving speed, it would be possible to predict the time at which the target
4 vehicle will pass future location checkpoints, allowing LEIA-TR to optimize pre-
5 caching. Among the many applications of pre-caching could be targeting of
6 advertising at strategically pre-designated location(s) of the mobile user or
7 providing the user with personalized physical location relevant sites of interest or
8 retailers (e.g., offering a user desired product(s), the targeting conditions for
9 which could be (previously) manually determined or performed automatically (as
10 detailed or referenced in the parent case). Or manually approved criteria or
11 objects of future anticipated proximity could be automatically recommend then
12 approved by the user for automatic notification if/when the object(s) (or objects
13 relevant to the recommended criteria) come into physical proximity to the user.
14 (E.g., some objects or criteria may not be determined to be definitively of high
15 enough priority to the user's preferences to justify active notification.

16
17 An extra layer of intelligence could be applied to situations in which a
18 novel route is being undertaken (indicating, for example, a cross-country road-
19 trip). LEIA-TR would then make use of phone and e-mail communications logs
20 (looking for location keywords), as well as the driver's personal calendar agent,
21 recent book purchases on Amazon.com, and so forth to determine the target's
22 final destination. Intermediate checkpoints would then be interpolated.

Of course, those automobiles equipped with on-board navigational systems (such as NaviStar) would very likely have been programmed by the driver, in advance, with specific navigational goals. Little inference would need to be done, in such cases, as long as the vehicle remained on track.

Inferring Information Content

Finally, given an appropriate portion of the input space I_C , the inferred driver D , and most likely path L_1, \dots, L_{final} , it should be possible to predict the content of the information that the driver will request. In many cases, this should be straight-forward, and could be implemented by another rule-base. Assuming that I_C includes the time-of-day, day-of-week, and the driver's history of information requests, it should be possible to capture the patterns of information usage for typical commutes (news in the morning, classical music on the way home) or weekend activities (surf updates on the way to the beach). The parent case (LEIA) discussed pre-caching "panels" such as this in anticipation of the driver's entering a particular region for which it is expected that higher resolution displays and more detailed information will be needed.

The driver, of course, has the ability to directly control the information he receives, of course, and can send LEIA-TR explicit instructions for information at the touch of a button (a driver might not have had time to finish the New York Times over coffee at breakfast, and could request the articles be read to him in

1 the car). Such exceptions to the non-parametric generation of likelihoods for
2 content interest would be hard-wired into the rule-base, and could take the form:

3
4 Rule 1. IF (emergency button pressed) THEN (link cell-phone to 911)
5

6 Other hard-wired exceptions might include road-trips; the rule-base,
7 recognizing a novel travel path, could hand off control of the information content
8 prediction routine to a nationwide travel system maintained by AAA, for example.
9 This could display road maps, information about tourist attractions, locations of
10 gas stations (when fuel runs low) and fast food restaurants (when lunchtime
11 approaches).
12

13 More sophisticated users could also be given access to the content-
14 delivery models directly; they could examine and modify the various thresholds
15 that determine information-delivery in fuzzier situations.
16

17 **Further Examples of Personalized Information Delivery Applications**

18 i) Targeted Advertising

19 If the user has a profile desirable to a particular advertiser, autonomous
20 user-side agents could negotiate certain terms and conditions for the packaging
21 of advertisements with the content to be delivered (The parent case expounds
22 upon the issued patent system for Generation of User Profiles by discussing
23 anonymous or pseudonymous user profiles which can be queried and accessed

1 easily by advertisers who pay or can negotiate terms for rights to deliver ads to
2 users).

3
4 The concessions by the user could include but are not limited to the user
5 allowing the advertiser to deliver ads (or other content) relevant to the user's
6 preferences via the in-car display (e.g., interspersed with other content which the
7 user has selected for consumption) or audibly via the automobile's radio speaker
8 system (either during a radio program's commercial breaks or otherwise) or via
9 an electronic billboard. In each of these cases, if the advertising is relevant to
10 the present location of the user, it may be preferentially delivered at those
11 appropriate time(s) and via the delivery medium most accessible to the user,
12 most opportune for the advertising message or otherwise preferred by the
13 advertiser though ultimately subject to the terms and conditions acceptable to the
14 user.

15
16 ii) Personalized Maps

17 It would be possible to provide on-board electronic map displays for
18 mobile users which would be customized according to the users' interests. The
19 maps could be programmed by the user to reveal certain categories of
20 information, such as restaurants, nightspots, shopping (or a particular desired
21 product), points of tourist or historical interest, etc.

1 The user can tune the system to be more or less selective in displaying
2 personally relevant items, with various filtering options. For example, it might
3 reveal only those restaurants which are low priced, ethnic, and open after
4 9:00pm. The system may also notify the user as s/he comes within physical
5 proximity of desirable sites.

6
7 iii) User-to-User Meetings

8 Such maps could also reveal the physical locations of other individuals
9 with whom the user may be interested in scheduling meetings or even
10 establishing a first-time contact (such a contact would be brokered through
11 autonomous agents capable matching users having similar personal profiles).
12 The parties' personal schedules in combination with current and predicted future
13 locations could be used to notify users, reveal mutual geographic locations, and
14 even suggest (and direct users to) appropriate venues.

15
16 iv) Real-Time Traffic Reports

17 A simple but useful application of LEIA-TR would involve the real-time
18 transmission of drivers' location information to a regional traffic-reporting bureau.
19 This information would be analyzed for the locations of current and near-future
20 traffic congestion, which would then be broadcast back to the drivers in the
21 region. On-board navigation systems would then suggest alternate routes to
22 individual drivers, given their current positions and predicted destinations.

1 **Application B: In-Car Warning System, for Driver**

2 Because LEIA-TR has access to data both inside and local to a given
3 automobile, it could be used to support a number of devices to improve safety for
4 both drivers and passengers.

5
6 In addition to the sensors and communications devices already installed in
7 a vehicle, it would be possible to add a small computer capable of
8 communicating verbally with the driver. Being connected to the central LEIA-TR
9 server via the wireless communications system, this device would be able to
10 override most other in-car information systems to verbally deliver important
11 safety messages to the driver, regarding events both within and external to the
12 vehicle.

13
14 In the first case, the device might notice that the car is being driven too
15 fast, conditional on the location, weather, traffic flow, and time. If several
16 accidents have occurred on the given stretch of road under similar conditions the
17 driver would be informed of this fact. Furthermore, communications with
18 personalized agents at the driver's home might reveal that the driver is lacking
19 sleep or has consumed alcohol, both of which would give the safety device
20 grounds for decreasing the threshold used to determine the need for a verbal
21 warning. Conversely, if a driver is going rather fast, but current conditions are
22 extremely good (straight road, no traffic, perfect visibility, warm and dry weather),

1 the device could increase its warning threshold to avoid needlessly bothering the
2 driver.

3
4 In addition to being linked to LEIA-TR's statistical databases, the safety
5 device would have access to observations of current road conditions. Thus,
6 given that a slippery patch of ice or traffic accident has been observed two miles
7 ahead of the driver's current position, and which fall within the driver's predicted
8 path, LEIA-TR could verbally warn the driver of the oncoming obstacle and
9 perhaps provide an alternate route. It is conceivable that, in the future,
10 automobiles themselves would be mounted with miniature weather stations that
11 would feed back into LEIA-TR. Thus, if a few cars encountered icy conditions on
12 a certain stretch of road, it would take very little time for warning information to be
13 sent to all vehicles heading for that location.

14
15 Such dynamically available weather information emitted from so many
16 closely situated sources would also be valuable to enhance real time weather
17 prediction models; e.g., If conditions producing ice, such as freezing rain, dense
18 fog, heavy rain or hail, etc., are imminently likely to occur based upon weather
19 patterns in the immediate vicinity, local warning could be issued for the imminent
20 possibility of such conditions.

21
22 Data from front-mounted infrared camera systems are already of use in
23 enhancing the real-time visual capabilities of drivers. In addition to warning of

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1 such conventional dangers as pedestrians or deer in the road, a LEIA-TR
2 enabled vehicle could add other information to the heads-up display to enhance
3 the safety of the driver. For example, notably dangerous curves in the road, or
4 recently-detected patches of ice could be highlighted. Or, the user could be
5 alerted to the presence of a high-risk driver (identified by previous criminal
6 records and current erratic driving). Anything deemed dangerous or worthy of
7 attention could be "painted" on the windshield through the heads-up display.
8 Especially useful during periods of low visibility, such a system would warn the
9 driver of obstacles and recommend evasive strategies. Multiple vehicles
10 equipped with LEIA-TR could automatically exchange locational data, thereby
11 allowing for coordinated movement during such periods.

12
13 Finally, the system could warn the driver when he is in danger of falling
14 asleep at the wheel (and suggest courses of action, such as the location of the
15 next motel or vendor of coffee); sleepiness could be inferred after long periods of
16 non-stop driving, and by cameras mounted inside the vehicle capable of
17 monitoring the driver's position and behavior (iris scanning is a useful way of
18 detecting alertness).

19
20 ***Application C: Emergency Notification System, for Police***

21 Once an accident has occurred, victims frequently rely on passers-by to
22 inform the proper authorities. If the accident has taken place in a remote location
23 or during a heavy snow-storm, the victims stand a good chance of not being

1 helped in time. If LEIA-TR's in-car system is still operational, it could use the
2 car's communications system to send an automated call-for-help accompanied
3 by the car's GPS coordinates, given that a certain number of anomalies have
4 been detected (a violent acceleration or impact was recently registered, the car is
5 positioned on its side or back, the driver is not responding to verbal pages, the
6 vehicle is not moving, etc.).

7 In some instances, it would be advantageous for those passers-by
8 qualified to provide emergency or medical assistance to be notified of a nearby
9 motorist in need of help. While sending out a call for help, LEIA-TR could assess
10 the severity of an accident (using previously suggested input variables) and
11 determine whether qualified (and willing) individuals capable of providing
12 emergency or medical help are in the vicinity.

13 In extreme cases, the in-car electronics may have been destroyed, as
14 well. However, because LEIA-TR monitors the positions of all its users (via
15 communicated GPS location stamps), the last known coordinates of a vehicle
16 could still be instrumental in the search by authorities for a missing driver.

17
18 ***Application D: Traffic Flow Analysis, for Highway Engineers***
19

20 In recent years, state highway departments have become much more
21 sophisticated in their management of traffic flow, notably by using tollbooth
22 systems able to dynamically adjust prices. Given that a morning rush hour is
23 going to clog inbound lanes, for example, it is possible to temporarily charge
24 drivers higher tolls for the use of principal arteries at critical times. This
25 encourages drivers to travel via alternative routes, or to shift their commuting

1 schedule away from peak hours. In a sense, the flexible tolls act as a market
 2 force that disperses incoming traffic across multiple routes and times, lessening
 3 overall traffic flow pressure.

4
 5 The calibration of such a system is not trivial, however, and in some cases
 6 may actually increase problems if traffic flows don't change in the manner
 7 predicted. LEIA-TR provides a solution to this.

8
 9 Located at the center of a complex web of inputs, LEIA-TR is able to
 10 record, in precise detail, the timing and direction of traffic flow, the estimated
 11 number of passengers, the types of vehicles, the state of the weather, the
 12 occurrence of traffic accidents, and overall road conditions. First of all, this
 13 information is highly useful for state-of-the-art traffic prediction models – given
 14 the time, date, weather, road conditions, and the state of nearby roads, LEIA-TR
 15 can efficiently forecast expected traffic flows. Moreover, a series of toll-setting
 16 experiments would provide LEIA-TR with the data needed to understand the
 17 incremental changes in traffic patterns due to toll prices, conditional on the
 18 current traffic state. The combination of LEIA-TR's extensive data-collection
 19 facilities with state-of-the-art statistical traffic models will therefore form the basis
 20 for a powerful new highway traffic control system. Finally it is worth to note that
 21 the ability to monitor and dynamically notify drivers of present or impending
 22 congestion problems can also provide valuable real time data to traffic reporting
 23 bureaus in a manner, which is much more accurate and up-to-date than current
 24 aerial based manual observation and recording.

1
2 LEIA-TR's ability to capture and provide for analysis, extremely detailed
3 traffic flow and congestion data as a function of time would provide extremely
4 valuable statistical data to state and regional highway departments and
5 engineers for purposes of augmenting optimal highway design and expansion
6 planning as well as associated budgeting to accommodate such needs. Such
7 data may further be useful in detecting driver behavior patterns at certain points
8 or stretches of roadway which are suggestive of being predisposed to future
9 accidents before they occur. Such statistics based informational systems could
10 be used to create computer created statistical models of maps at regional or
11 national scale revealing traffic flow patterns based upon various desired analysis
12 criteria.

13
14 ***Application E: Insurance Analysis, for Automobile Insurance Companies***
15

16 By pulling together massive amounts of finely detailed information on
17 automobile drivers and their behaviors, LEIA-TR could be of great utility to the
18 insurance industry, which relies on high-quality data for the construction of its
19 pricing models. The data collected by LEIA-TR will exhibit both a quantity and
20 quality of detail far exceeding that seen in insurance databases today, allowing
21 for the construction of new generations of insurance models and insurance
22 applications.

23
24 It should be noted that this example is intended to illustrate how LEIA-TR's
25 powerful data-collection facilities can be of practical use to a currently existing field.
26 Actuaries have developed a body of specific pricing models to analyze claim data

1 and personal policyholders' characteristics. These models have a double goal: first
2 they aim at selecting the classification variables that are the most powerful in
3 explaining loss data; then they use the selected variables to establish premiums for
4 the various levels of coverage. Early models were based on selection techniques
5 of regression analysis, but more specific models have been developed lately. The
6 study of these models is part of the curriculum in most college actuarial programs
7 around the world. In the United States, rate-making is the main subject of an
8 examination administered by the Casualty Actuarial Society.

9
10 An overview of the main pricing models can be found in:
11

- 12 • "Introduction to Ratemaking and Loss Reserving for Property and Casualty
13 Insurance" Robert Brown, Actex Publications, Winsted, CT, 1993
- 14
15 • "Rate-Making" J. van Eeghen, E. Greup and J. Nijssen, Surveys of Actuarial
16 Studies #2, Nationale Nederlanden, Rotterdam, 1983

17
18 ***a. LEIA-TR's contribution to auto insurance: the collection of highly-***
19 ***detailed behavioral data***

20 By its very nature, the LEIA-TR architecture is ideally suited for the
21 collection of highly-detailed information about motorists -- their vehicles,
22 behaviors, and locales. In this particular implementation, however, LEIA-TR will
23 be operated less for the purposes of real-time interaction, and more as a passive
24 data-collection system. However, the quality of this new data will be so precise

that it is likely that entirely new classes of actuarial models will be based on it. Such models could be developed by applying linear as well as non-linear (e.g., kernel regression) analysis techniques to the following:

- identity of driver and number of passengers
- driver's age, sex, economic class, road behavior, sobriety
- seat belt and child-seat usage
- routes traveled (dates, times, speeds, and distances)
- adverse conditions (weather/road)
- annual mileage
- vehicle overnight location
- accident details (exact point of impact, speed at impact, wheel movement, effect of braking, etc.)

b. Application to Car Insurance Rate-Setting

The fundamental principle of insurance consists of forming a pool of policyholders. If all risks are not equal to each other, it is fair to ask each member of the pool to pay a premium that is proportional to the risk imposed on the pool. The main task of the actuary who sets up a new rating system is to partition the portfolio into homogeneous classes, with all drivers of the same class paying the same premium. The actuary has to subdivide the policies according to *classification* or *rating* variables; for instance, it has been shown in numerous statistical studies that young male drivers are more prone to accidents

1 than adult females. Consequently age and sex of the main driver are used in
2 most countries as rating variables, with heavy surcharges for young males. The
3 identification of significant rating variables is an arduous task, that uses
4 sophisticated actuarial models based on multivariate statistical techniques.

5
6 The main variables currently used in most US states are

- 7
- age, sex, marital status of main driver
 - 8 • car model (sports cars pay a hefty surcharge, for instance)
 - 9 • use of car (usually as a function of commuting mileage)
 - 10 • territory (overnight location of vehicle)
 - 11 • traffic violations and past accidents (over the past three years)
 - 12 • other variables commonly used include good student discount, multi-
 - 13 car discount, driver training discount, passive seat-belt discount, etc.
- 14

15 Data provided by LEIA-TR could improve the accuracy of rating in a
16 tremendous way, by using the variables that have the best predictive power.
17 LEIA-TR will revolutionize rating, by enabling insurers to select the most efficient
18 rating variables. Currently, insurers have to rely on many proxy variables,
19 variables that are notoriously inferior in terms of rating efficiency, but that need to
20 be used since the best variables are either unavailable or subject to fraud. For
21 instance:

1 1. Commuting mileage is used, as it is fairly easy for insurers to check (even
2 though it is subject to fraud: many policyholders claim they take public
3 transportation to work, while in fact they drive.) Commuting mileage is a poor
4 variable, as it fails to take into account pleasure mileage, vacation mileage,
5 use of car during the dangerous night hours. Annual mileage is a much better
6 predictor of accident behavior than commuting mileage. Yet insurers are
7 reluctant to use annual mileage, as it is subject to underestimation by
8 policyholders. LEIA-TR could provide that useful information with accuracy,
9 at a cost that would be substantially less than the cost of an annual physical
10 inspection of the car's odometer.

11 2. Sports cars are not dangerous *per se*. The driver of a sports car usually is.
12 The rationale for the use of sports car as a rating variable is that it is a fairly
13 good proxy for the variable "driver of a sporting nature." By recording
14 aggressive behavior on the road (maximum speed, accelerations, heavy
15 usage of brakes, etc.) LEIA-TR could correctly identify dangerous drivers and
16 tailor the surcharge for aggressive road behavior to the true driving pattern of
17 the policyholder. This would also save companies the expense of organizing
18 regular experts' meeting to decide which car model has to be classified as a
19 sports car.

20 3. Moving traffic violations constitute a very poor evaluation of the respect of the
21 driving code. Only a minuscule percentage of effective violations of the code
22 lead to a police ticket. Moreover, the collection of traffic violation data is a
23 very expensive procedure, as it implies constant contact between insurers

1 and the state's Motor Vehicle Agency. LEIA-TR could provide an accurate
2 measure of the respect of the traffic code by insureds.

3 4. Discounts for good students or participation in driver training are weak
4 attempts at identifying responsible young drivers. LEIA-TR could monitor the
5 road behavior of young drivers much more accurately.

6 5. Insurers award a discount to cars equipped with passive seat belts, as they
7 have currently no way of checking effective seat belt usage by drivers. With
8 LEIA-TR, a much better variable (effective usage of seat belt) than passive
9 seat belts could be used.

10 6. A current debate concerns the competency of elderly drivers: Although driving
11 ability may degrade with age, it does so at different rates for different drivers,
12 making it impossible to specify a general age threshold past which people
13 cannot drive. In passively monitoring driving behavior, LEIA-TR may do an
14 excellent job of extracting those features related to impaired reflexes,
15 competency, and mental/sensory awareness. This information could be used
16 to devise a much more accurate measure of an elderly driver's ability to drive
17 safely.

18 7. Insurers currently have no way to measure a driver's likelihood of driving
19 under the influence of alcohol. LEIA-TR would be able to conduct such
20 measurements, using in-car breathalizers or by detecting patterns of driving
21 normally associated by law enforcement officers with DUIs.

1 These examples show that the data provided by LEIA-TR could be used to
2 analyze and segment the driving population with a high degree of accuracy,
3 allowing the particular risk of an individual driver to be accurately calculated and
4 priced. Rather than being priced by rough demographics, an individual's
5 insurance premium would be tailored-made for his particular situation and driving
6 behavior. Insurance carriers making use of the data collection capabilities of
7 LEIA-TR would enjoy a tremendous competitive advantage over companies that
8 don't use LEIA-TR. They would be able to use a much more efficient set of
9 classification variables, select the better risks, and consequently improve
10 profitability.

11
12 Although a finer-grain classification of drivers and their behaviors would be of
13 great use to insurance companies, there are substantial regulatory requirements
14 which need to be overcome (on a state-by-state basis) before such algorithms
15 can be legally used. In light of the need to improve the political acceptability of
16 such methods, an alternative embodiment of LEIA-TR, which further protects the
17 privacy of individual users, is presented here.

18
19 It is possible to put the pseudonymous proxy server (as described in our
20 pseudonymous server patent) under the control of a user-side agent, which
21 would also have access to the insurance companies' actuarial models. The
22 agent would automatically determine which portions of the driver's behavioral
23 profile should be forwarded to the insurer, with the goal of minimizing premium

1 costs to the driver. The information forwarded by the agent could not be
2 tampered with by the driver, although he would have the option of manually
3 switching off any portion of the information feed he desired. In this model, there
4 is an effect of "incrimination by default" as poor drivers would invariably disclose
5 fewer key components of their profiles. Thus, on a variable-by-variable basis
6 those drivers disclosing less information to insurers would pay higher premiums
7 than safe drivers willing to disclose their complete driving logs, but in doing so
8 would protect their privacy.

9
10 Of course, information of interest to automobile insurance companies
11 would extend beyond simple driving behavior, and might include information
12 gathered from medical records (e.g. containing information on drug use/abuse,
13 seizure disorders, depression, visual impairment, etc.) or health insurance
14 companies (with whom automobile insurance companies might find it
15 advantageous to trade data).

16
17 By publicizing the information learned in their analyses, automobile
18 insurance companies could feed advice on safer driving back to individual
19 drivers, who would have an incentive to modify their behavior. As a driver
20 learned to drive more defensively, his user-side agent would automatically
21 release more information about his behavior to the insurance company, gaining
22 him cheaper premiums.

1 **c. Insurance Fraud Detection**

2 LEIA-TR's extensive data collection facilities would be ideal for detecting
3 (or at least flagging) insurance fraud, as well as cutting overall investigation
4 costs. A few examples:

- 5
- 6 1. Territory is a variable subject to intensive fraud. So many policyholders use a
7 fake address in rural South Jersey to avoid the Philadelphia surcharge that
8 companies hire teams of private investigators to patrol the streets of
9 Philadelphia at night, to identify cars with New Jersey license plates. This
10 expensive and inefficient procedure could be eliminated with LEIA-TR's ability
11 to record location information.
- 12 2. In their applications, prospective policyholders have to record the percentage
13 of use of each car by each member of the family. Usage by young drivers
14 tends to be systematically underestimated. LEIA-TR could efficiently combat
15 this fraudulent technique. For example, a car parked during the day at a high
16 school would reveal that the usual driver was most likely a teenager, although
17 the family buying the insurance has registered the father as being the
18 exclusive driver. One of the rating difficulties faced by insurers nowadays is
19 that they do not have a cost-effective way to verify who the "main driver" of
20 each car is. LEIA-TR may be an answer to this major problem.
- 21 3. The "black boxes" installed in LEIA-TR users' cars record every detail of a
22 vehicle's workings (speed, direction, force of impact, etc.); this should allow
23 for extremely accurate accident reconstruction's, which could be checked

1 against accident claims. This would make it easier to correctly attribute
2 liabilities and to gauge the likelihood of various types of injuries. For
3 example, if the black box shows that an accident happened at a speed of
4 fifteen miles per hour, claims of whiplash could be successfully contested. As
5 long as a vehicle isn't completely demolished, the sensor devices would
6 continue to monitor post-accident events, which might also prove important
7 for later claims (e.g., if a supposedly immobilized driver is later identified
8 pushing the vehicle).

9
10 In summary, LEIA-TR promises to be an extremely useful tool in reducing
11 a major problem to insurance companies: information asymmetries. Such
12 asymmetries, called adverse selection and moral hazard, arise when the
13 company has difficulty in assessing the risk of each policyholder. Adverse
14 selection arises from the improper classification of each risk. This cost is
15 transferred to the policyholders in the form of increased premiums: a result of
16 imperfect information is that the 'good' drivers are subsidizing the 'bad' drivers.
17 In addition to adverse selection, insurers face a moral hazard externality. The
18 purchase of an insurance contract reduces the incentive of policyholders to act in
19 a matter that minimizes the likelihood of a loss. Moral hazard occurs because
20 policyholders act in a way that is unobservable to the company.

21
22 LEIA-TR's data collection provides individual-specific information that will
23 increase the ability of the insurance company to discern between the drivers'

ability and behavior, reducing adverse selection. This will allow the proper categorizing of each risk. Good drivers will be rewarded, bad drivers will be penalized. As a result, the proper recognition of driving ability will reduce subsidization of the bad drivers. Their premiums will increase. Consumer monitoring will reduce unobservable behavior, decreasing the effect of moral hazard. In view of these decreased externalities, substantial premium reductions will likely be offered to vehicles that have LEIA-TR.

d. Alternate Embodiments

Although the embodiment described above provides a solution specifically for the determination of automobile insurance, LEIA-TR could substantially improve other types of actuarial models.

a) Life/Health Insurance -- Certain risky behaviors, such as excessive speeding, driving under the influence, or failure to use seatbelts regularly are factors observed by LEIA-TR which should have a definite impact on life and health insurance calculations. It would be possible to extend LEIA-TR's capabilities so that non-vehicular activities could be also detected and analyzed. For example, once a driver has left his vehicle and moves on foot, LEIA-TR would acquire LIDs from local dial-up exchanges, point-of-sale purchases by credit card, ID badge scans, cell-phones, two-way pagers, hotel and airport transactions, etc. Combining this information (which allows LEIA-TR to track the time and location of a pedestrian's route) with information describing local conditions (crime, traffic,

and pollution levels), an extremely detailed set of data relevant to health and life insurance companies could be developed. This archive of information could then be used to gauge the level of risk in the full range of an individual's daily behavior, both inside and outside his vehicle, allowing the insurance company to set prices accordingly.

b) Aircraft Insurance: As another example, pilot and airplane insurance could be more accurately priced using panel data sets collected and analyzed by LEIA-TR. In this mode, LEIA-TR's inputs would include air traffic control systems (for location/altitude data), "black boxes" (on-board flight recorders which catalog in high detail the particular operations of a given airplane), pilot ratings, maintenance records (giving the age and mileage of various components), weather logs, and the like. In addition to aiding insurance companies, such a comprehensive collection of information would undoubtedly be of use to companies in the business of building safer and more reliable airplanes.

Application F: LEIA-TR and Marketing

1) Database Marketing Companies

Some GIS software companies provide geographic mapping software solutions for database marketing companies, see www.caliper.com. Using the iReactor technology, it is possible to correlate demographic data of on-line users with other types of content and purchasing preferences as demonstrated on-line.

1 These preferences may be either captured on a site-specific basis and/or
2 (ideally) via the preferences elicited by the user across all sites that the user
3 visits. Given these correlations, it is possible to utilize these demographics to
4 identify on a location specific basis the most prevalent content and consumer
5 purchase characteristics of those on-line users which are most similar to the
6 demographic profile which characterizes that geographic region. As a result, off-
7 line advertising campaigns can be better targeted.

8 9 2) Market Information for Retailers

10 Using LEIA-TR the complete profile and retail transactional histories of
11 users can be determined such that it is possible for retailers to gain access to this
12 data to determine the product propensity buying patterns of individuals who
13 browse aisles of their stores, who physically drive or walk past or near their
14 stores or more subtle information such as those who browse but don't purchase,
15 those who browse, don't purchase but have a predicted propensity to purchase
16 the types of inventory selections available, or are average or high-end
17 purchasing customers. This information could be used to allow the retailer to
18 make deductions about such things as overall inventory selection, the
19 prominence of certain selections in the store, the product or special discount
20 advertisements that would be most efficient to advertise at the front of the store
21 or to pedestrians outside
22

3) Mapping Commercial Industrial and Residential Real Estate Market Opportunities

A very useful application of LEIA involves the collection of traffic pattern data on a time-specific basis (the day of the week and time of day) for the traffic, as it passes each piece of real estate. An electronic map, which is ideally Web-based, is generated and constantly updated based upon this data, which will be useful for assessing the commercial and residential real estate possibilities of a given location.

Additional information may be provided which may include (but is not limited to):

- a. Origin and destination information of the vehicular traffic (as captured by LEIA) which may, especially if correlated with time, suggest the nature and context of the driver's activities, e.g., rush hour traffic, errand traffic, etc. It may be useful to factor in the type of neighborhood the vehicle returns to every night, the type of commercial or business entity she/he drives to work to each day, etc.
- b. Other activity-related clues which the user is willing to release, e.g., devices interacted with, content interacted with or transmitted information, etc., which may provide insights into the mind-set of which users tend to experience when in the vicinity of the real estate property.

1 c. User Profile Data – Aggregate purchase and content affinities as well as price
2 elasticity data (gleaned from purchase statistics) could be very useful information
3 to commercial real estate developers and purveyors. Users with the right profile
4 and a receptive mindset are of particular interest.

5
6 It should be noted that the present system may be extended to residential
7 real estate. E.g., what types of jobs (such as quality of jobs) do local commuters
8 have? What are their numbers? How far do they commute (particularly if they
9 tend to commute further than the present real estate site)? Do their commuting
10 routes tend to pass the current potential real estate site? The last three
11 questions would also be particularly relevant as well for a prospective industrial
12 real estate development opportunity.

13
14 Industrial real estate developers also may be interested in mapped models
15 of real estate depicting the professional and known likely educational
16 characteristics of the associated local residents in that region? What are the
17 other businesses at which they work? (If available) what are their particular
18 positions/responsibilities?

19
20 4) Creating Traffic and User Profile Models of Traffic Passing Billboard Sites and
21 Providing a Map of Such Information on an Available Billboard Site Basis –
22

1 The presently described techniques for providing dynamically updated
2 informational maps containing detailed statistical data regarding vehicular traffic
3 passing real estate sites can be further extended to similar maps of interest to
4 advertisers which contain locations for available highway billboards. The present
5 system further provides Web-based access, which enables advertisers to make
6 reservations and purchases of such billboards. In one preferred variation, an
7 economic model is deployed to optimally price the billboards. I.e., a varied
8 representative sample of each type of billboard sharing similar traffic/user profile
9 features with others is auctioned for this purpose. In another variation this on-
10 line auction model is deployed for all billboards available by the system in order
11 to provide a novel service to advertisers which is a "billboard auction" site.

12
13 ***Application G: LEIA-TR and e-Commerce***

14 1) Dynamic Monitoring/Recording of On-Line Traffic Patterns of Visitors to a
15 Web Site
16

17 Real time data mining analysis of Web-wide visitor traffic flow statistics
18 using traffic flow analysis tools in combination with data mining tools, can reveal
19 (in real time):
20

21 a) Where user traffic from the site is coming from, by geographic region of the
22 POP through which the user (who may be mobile) is accessing the network
23 server. Possibly physical address of the users may be reloaded as well for data

1 aggregation purposes. This information may be of value to vendors who desire
2 targeting the user with advertiser desired information, i.e., targeting by desired
3 profile features and/or location characteristics with detailed knowledge of what
4 are the typical site navigation and/or product purchase characteristics of the
5 users possessing certain profiles and how do they compare with other visitors.
6 What are the comparative statistics between different types of user profiles.

7
8 b) The sites the user is coming from and going to with regards to the vendor's
9 site. From this data, we can correlate specific geographic and Web usage
10 characteristics with certain types of actions on that vendor's site; e.g., where
11 geographically, do most of the high spending customers within product category
12 X come from, from which competitors do most of these customers go to,
13 particularly when they stop coming back to the site (or more generally, what
14 characterizes the behavior of these wayward customers)? What other sites or
15 content do users with certain product consumption characteristics tend to prefer?
16 Real time site usage and product transaction statistics can thus reveal which
17 advertising campaigns (on-line or off-line) are most successful (as measured
18 through real-time feedback). From which geographic regions (and Internet sites)
19 does each campaign (and media type) elicit the greatest on-line user response?
20 These performance statistics can even be measured on a product or category
21 level. It is further of value to consider what are the spending patterns
22 (particularly on competitor sites of certain desirable customer segments (e.g.,
23 which either represent the profile features of that vendor's typical customers or

top customers). (Note that such data could be accessed in aggregate from the ISP by regional POP server or even wireless capturing data transmissions from the wireless ISP or cellular provided also pertaining to off-line transactions invariably further requires active cooperation with the user, e. g. at the client or network proxy level and/or his/her transaction processing entities such as credit cards and bank.

c) In a similar extension of the system, we can provide advertisers with a nationwide overview using GIS software of where, geographically, their ideal target prospects are located. Again off-line campaigns can be better targeted and if the products/services of the advertiser are location dependent, she/he can set rules to target individuals who are near the advertiser's physical site or, conversely, near a competitor's site (again subject to terms/conditions as negotiated between the advertiser and customer). If these customers at the point of purchase are willing to reveal their profiles (such as physical address and site usage statistics), off-line vendors can better determine where to target off-line campaigns and on which sites to deliver their advertising for their off-line products/services. What's more, iReactor can measure the immediate transaction response rate by product as these various campaigns are initiated; thus validating and quantifying the direct commercial benefits to the vendor, e.g., geographics, advertising in certain regions or demographics, or sites could be directly correlated to spikes in sales volumes within X category(s) of the products or services.

1
2 If the user is willing to further reveal real-time anonymized location data
3 about themselves, the system is able to identify the particular physical location(s)
4 which best reach the target audiences as well as subsequently measure the
5 direct effectiveness of these billboard campaigns, e.g., X percent of users who
6 pass a billboard Y or billboards with message Z make a related purchase with
7 that vendor.

8
9 Why limit marketing performance analysis to a vendor? iReactor can
10 provide much of this same intelligence about the competition, e.g., what on-line
11 (or even possibly off-line) advertising messages result in traffic and purchase
12 activities on-line for that competitor.

13 14 2) Personalized Search Engine

15 A personalized search engine which considers the content domains of
16 interest to the user and what types of results other individuals most like that
17 particular user tend to retrieve and ignore given a particular query. This data in
18 combination with the search activities of the user enable this system to learn how
19 to better personalize future search results for that user. Both the portal and
20 search engine could be further personalized based upon the physical location
21 user, or alternatively, a physical region(s) manually entered by the user. It is
22 reasonable to allow the browsing interface to enable the user to access menus
23 (e.g., heirarchical) site listings, search results or particular URLs and navigate to

1 other sites based upon content similarity, location similarity (or both) or to
2 navigate sites based upon modifying these criteria.

3 4 3) Personalized Content

5 Personalized Content Such as Radio or Other Multimedia Information
6 Customized by Location of the User - With the advent of increased bandwidth
7 over wireless networks and decreased cost of local memory, it is certainly an
8 appropriate application to provide the user with more robust, personalized and
9 location development content, such as multimedia with video/audio components
10 via the automobiles on board multimedia terminals. This content may include
11 advertising, news, weather, relevant privileged news stories or financial
12 information.

13
14 A Generalized major portal search and Web browser interface – All of this
15 information may be both multimedia (video and audio) or as desired by the user,
16 it may preclude strictly an audio component. The system may constantly feed
17 information to the user which is automatically personalized, based upon manual
18 search or filtering criteria and/or relevance to the specific location of the user, as
19 the user comes into physical proximity to sites or objects of interest. Or in a
20 variation of the location filtering features, the user may specify a particular
21 location or locations which are of interest manually instead of, passively,
22 receiving information which is relevant to the user's present temporal location.
23 Certainly, notification is one mode by which the system can be used such as

1 either automatically based upon that information which is automatically measured
2 to be above a certain predicted threshold of interest to the user or as based upon
3 manual preference settings. This information may be either location relevant or
4 alternatively may be information delivered via broadcast radio or satellite TV
5 (e.g., radio news for which stories of high-level personal interest are delivered to
6 the user on a specifically user designated channel(s) or from any channel while
7 the user is in an active listening mode or while the radio is turned off. (The virtual
8 radio channel concept was discussed in issued patent "System for the
9 Customized Electronic Identification of Desirable Objects"). Radio content
10 whether broadcast or unicast could certainly be specifically targeted based upon
11 regional relevance (e.g., categories such as news stories, regional ads for fine
12 dining, etc., which are regional or highly regionally specific to the present location
13 of the user

14
15 4) "What's related" Links

16 Providing an Alexa-like functionality to the personalized portal. It is
17 reasonable to bias these personalized portal links also by the present location of
18 the user and GIS software can be used to show the geographic locations of
19 physical sites, vendors, and products associated with the personalized location
20 enhanced portal. The parent case also describes an automated technique based
21 upon the content analysis methods for detecting and automatically generating
22 links to the pages which are most related to a given page.

1 5) Location-specific Web Pages

2
3 If desired, as a user browses from site to site, this GIS map could be
4 represented as a persistent button on the browser display which allows the user,
5 with the click of a mouse, to pop up a GIS map, showing the physical location of
6 the vendor, products/services or Internet site, geographically as the user views
7 the page. In fact, in a more advanced version any content which is
8 geographically relevant could be represented in this manner. Place names in the
9 text can be correlated with the associated physical locations on the map. E.g., a
10 news site such as world news could allow the user to observe news events as
11 they occur.
12

13 6) Personalized Recommendations by Vertical

14 The iReactor recommender engine can also provide search and filtering
15 capabilities by particular vertical industries. An example of a particularly
16 commercially compelling vertical may include a travel portal which allows a user
17 to view travel destinations on a GIS map, zooming on desired (or personally
18 recommended) locations or attractions and then view multi-media displays of
19 those selections. The present functionality could be usefully integrated into a
20 general automobile (or pedestrian) GIS and navigational system (as described
21 above) enabling (via notification of persistent or selective content feed) delivery
22 of location relevant fraud information via the portal.
23

1 7) Bargain Finder

2 The user is browsing a vendor's site with his/her (PDA or stationary PC)
3 and identifies and an exotic fragrance from Victoria's Secret. The system may
4 reveal to the user not only other vendors which sell that perfume but also
5 whether or not it is presently in stock, the locations of these other vendors, (e.g.,
6 ranked in ascending order of physical distance, price or other feature or
7 purchase/delivery related information). GIS can then accordingly provide a
8 mapping display revealing the geographic locations of the various vendors as
9 listed by the bargain finder. GIS can further reveal the preferred driving routes
10 for each vendor given the user's present location (and using GPS) even
11 dynamically instruct the user of which street or road to follow, dynamically while
12 en route reveal their geographic distances and GIS location with associated
13 pricing and other relevant buyer information.. The system may even be used
14 whereby this functionality could be provided as a solution for individual sites.
15 The user's PDA is used to scan a bar code or enable the user to input a universal
16 identifier code or name of a product which the user browses in a store. The
17 system will identify that product along with price, features, etc. in all other local
18 vendor stores(as well as possibly on-line). What's more, the iReactor
19 recommender engine could even recommend up-sells, cross-sells and other
20 products which are also liked by users who prefer that item.
21 This technique (particularly with the per-item inventory availability function), can
22 be used to direct the user to the most convenient location which matches the
23 desired criteria, or in a variation, to also replace a given item when it must be

1 replenished from the user's kitchen. In this way the system can even manage a
2 home maker's shopping list. The system may even reveal to each of these
3 vendors detailed information including comparative statistics regarding what
4 factors tend to affect the user's purchasing decisions compared with that of the
5 competition. Each vendor may then set customized rules which act in response
6 to certain user features to better capture buyer loyalty (e.g., automatically provide
7 counter-offers to combat a competitor's discounts, offer home delivery, etc., or
8 other value added benefits).

9
10 An example of a particularly commercially compelling vertical may include
11 a travel portal which allows a user to view travel destinations on a GIS map,
12 zooming on desired (or personally recommended) locations or attractions and
13 then view multi-media displays of those selections. The present functionality
14 could be usefully integrated into a general automobile (or pedestrian) GIS and
15 navigational system (as described above).

16
17 8) Real-Time Information Delivery to On-Line Shoppers Regarding the Location
18 and Present Delivery Capability of a Delivery Truck or Mail Truck Containing a
19 Desired Object(s)

20
21 Co-Pending Patent Application Entitled "Secure Data Interchange"
22 suggests an intriguing and novel application for LEIA-TR in which users browsing
23 an on-line retailer are able to receive updated real time information regarding the

present whereabouts of a subset of inventory selections offered on-line and which are carried by a deliver truck or alternatively a mail truck whose inventory selections are based upon the preferences of the users who tend to access that site. Along with each inventory selection which is also carried by a regionally local delivery or mail truck, the price (which is directly related to the transit time of the nearest available vehicle carrying that particular selection. Marketing models can be used to determine the optimal price which a vendor can request in which pricing parameters may be initially set based upon an auctioning approach.

4. Conclusion

Although this detailed example has focused on automobiles, the system described by this patent is relevant and applicable to any and all forms of transportation.

Overall, LEIA-TR offers a novel and useful new approach towards collecting and making active use of data that is currently being lost in the day-to-day flow of transport systems.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

1

1 What is claimed is:

2 1. A method of communicating:

3

4 (a) acquiring location information for a plurality of mobile communicants;

5

6 (b) identifying a particular mobile communicant;

7

8 (c) accessing a personal profile for said particular mobile communicant; and

9

10 (d) delivering digital content to said particular mobile communicant based upon
11 preferences identified in said personal profile.

12

13

Figure 1: Schematic of LEIA Process

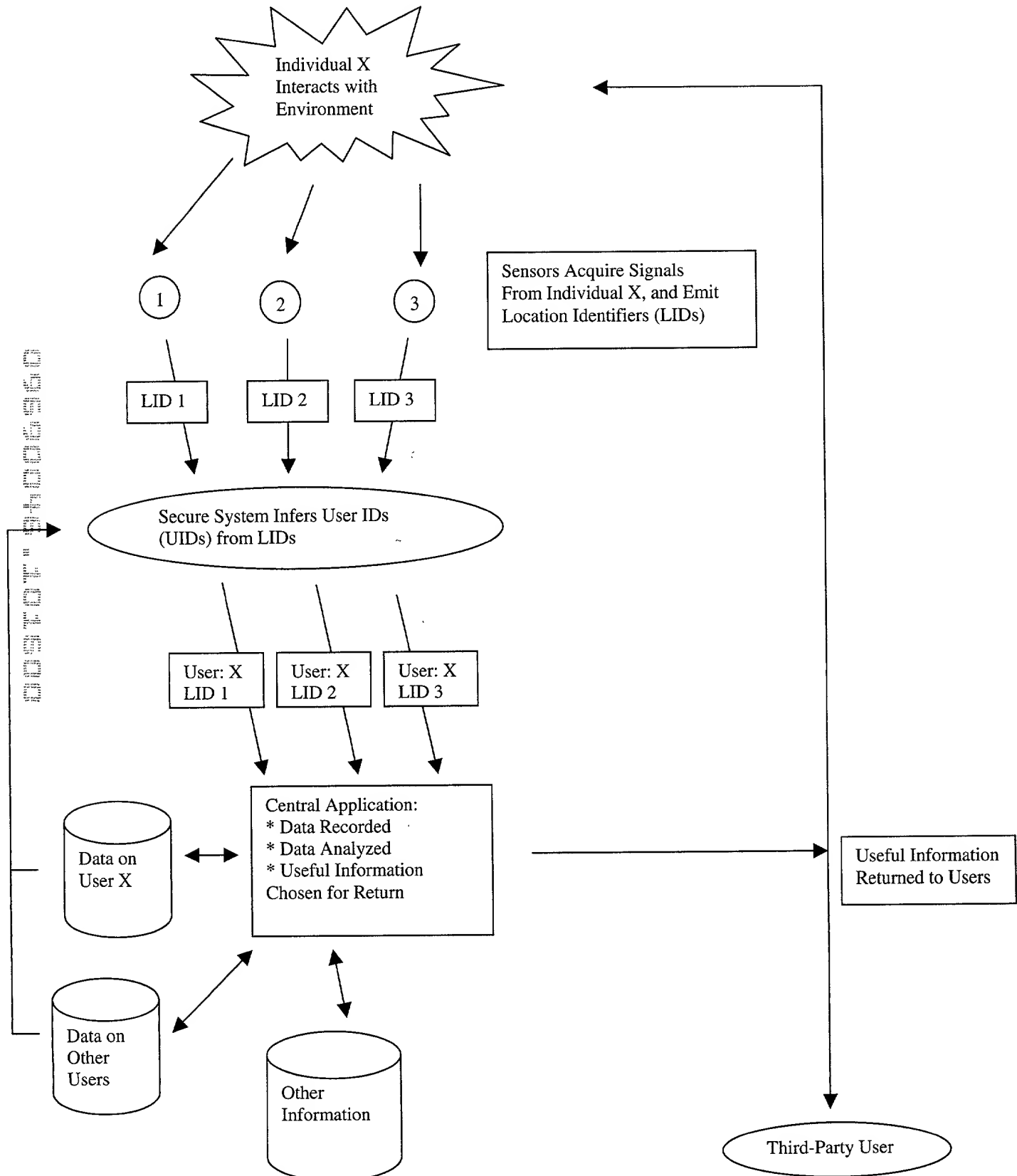
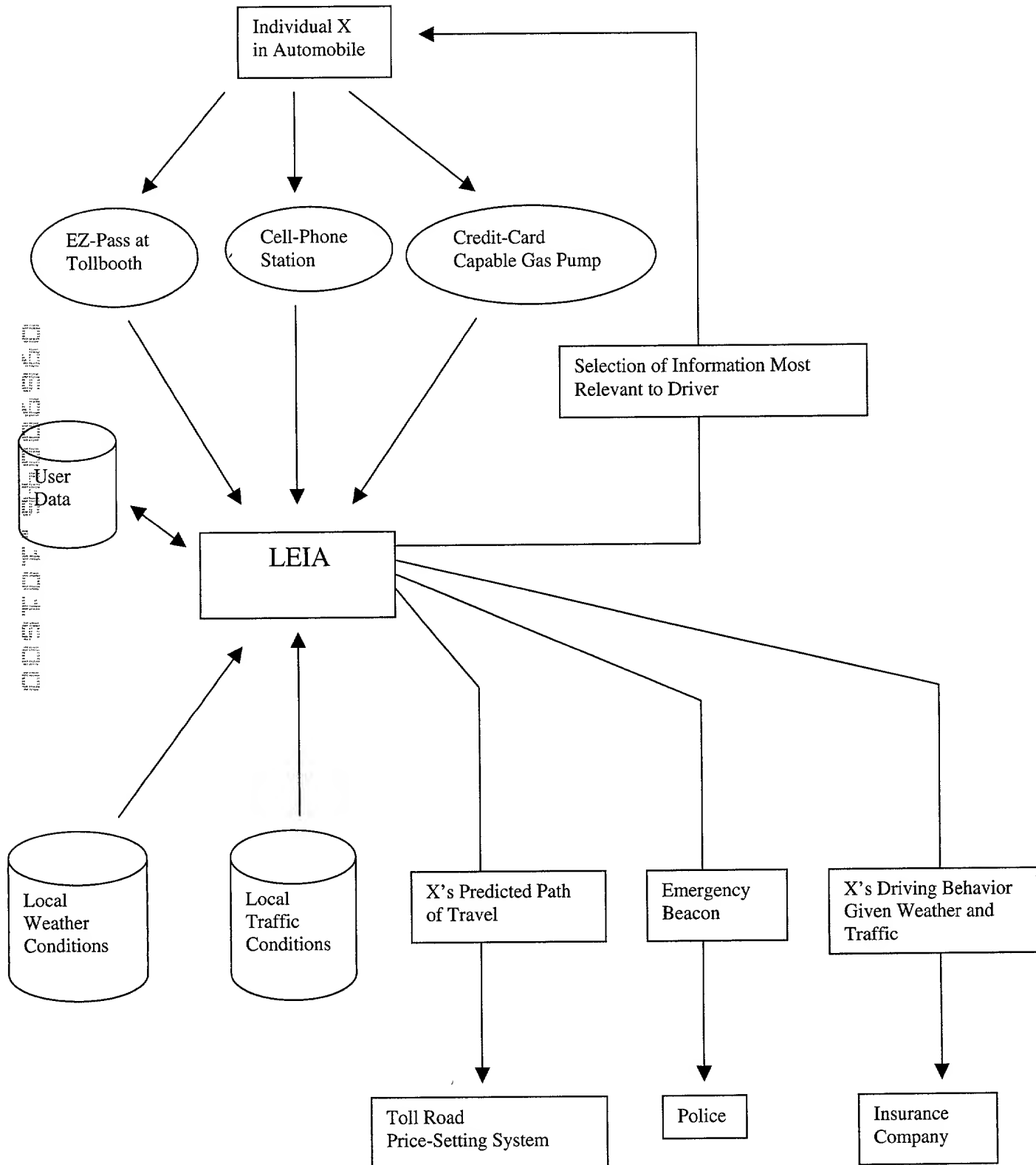


Figure 2: Simplified Example of LEIA Applied to Automobiles



DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name,

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**SYSTEM FOR COLLECTING, ANALYZING, AND TRANSMITTING
INFORMATION RELEVANT TO TRANSPORTATION NETWORKS**

the Specification of which is attached hereto, and being further identified as Attorney Docket No. 0635MH-40860.

I hereby claim the benefit under 35 U.S.C. § 120 of U.S. Provisional Patent Application No. 60/159,772, filed 15 October 1999, titled "System for Collecting, Analyzing and Transmitting Information Relevant to Transportation Networks."

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint Melvin A. Hunn, Reg. No. 32,574; Kenneth C. Hill, Reg. No. 29,650; and James E. Walton, Reg. No. 47,245 to prosecute this application and to transact all business in the U.S. Patent and Trademark Office in connection therewith.

Please send all correspondence to:

Melvin A. Hunn
Reg. No. 32,574
Hill & Hunn, LLP
201 Main Street, Suite 1440
Fort Worth, Texas 76102
(817) 332-2113 (voice)
(817) 332-2114 (facsimile)
melhunn@hillandhunn.com (e-mail)

Inventor's Signature: _____
Full Name Of Inventor: **Frederick M.S. Herz**
Date of Signature: _____
Residence Address: Warrington, Pennsylvania
Citizenship: USA
Post Office Address: Same

Inventor's Signature: _____
Full Name Of Inventor: **Pierre Lemaire**
Date of Signature: _____
Residence Address: Philadelphia, Pennsylvania
Citizenship: USA
Post Office Address: Same

Inventor's Signature: _____
Full Name Of Inventor: **Jean H. Lemaire**
Date of Signature: _____
Residence Address: Marlton, New Jersey
Citizenship: Belgian
Post Office Address: Same

Inventor's Signature: _____
Full Name Of Inventor: **Paul Labys**
Date of Signature: _____
Residence Address: Carrboro, North Carolina
Citizenship: USA
Post Office Address: Same

0635MH-40860

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. 0635MH-40860

In re Application of:

FREDERICK S.M. HERZ, ET AL.

Serial No. **TO BE ASSIGNED**

Filed: **HEREWITH**

For: **SYSTEM FOR COLLECTING,
ANALYZING, AND TRANSMITTING
INFORMATION RELEVANT TO
TRANSPORTATION NETWORKS**

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POWER OF ATTORNEY

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

HERZ TECHNOLOGIES INCORPORATED, assignee of the entire right, title, and interest in the above-identified application filed herewith and being further identified by Attorney Docket No. 0635MH-40860, hereby appoints the following attorneys to prosecute this application and transact all business in the U.S. Patent and Trademark Office connected therewith:

Melvin A. Hunn, Reg. No. 32,574; **Kenneth C. Hill**, Reg. No. 29,650; and
James E. Walton, Reg. No. 47,245.

Send all correspondence to:

Melvin A. Hunn
HILL & HUNN, LLP
201 Main Street, Suite 1440
Fort Worth, Texas 76102
(817) 332-2113 voice
(817) 332-2114 facsimile
melhunn@hillandhunn.com (e-mail)

0635MH-40860

Variable	Mean	SD	Min	Max
Age	34.5	10.5	18	65
Gender	Male			
Marital status	Married			
Occupation	Manager			
Income	10000	5000	5000	20000
Education	High school			
Religion	Buddhist			
Health status	Good			
Smoking status	Non-smoker			
Alcohol consumption	Non-drinker			
Exercise frequency	Once a week			
Stress level	Low			
Sleep quality	Good			
Appetite	Normal			
Weight change	Stable			
Blood pressure	120/80	10/10	90/60	160/100
Blood sugar	100	20	80	140
Cholesterol	200	50	150	250
Triglycerides	150	40	100	200
Hemoglobin A1c	5.5	0.5	5.0	6.0
Uric acid	5.0	1.0	4.0	6.0
Creatinine	1.0	0.2	0.8	1.2
Proteinuria	None			
Retinopathy	None			
Neuropathy	None			
Cardiomyopathy	None			
Arrhythmia	None			
Heart failure	None			
Stroke	None			
Hypertension	None			
Diabetes	None			
Obesity	None			
Depression	None			
Anxiety	None			
Substance use	None			
Family history	None			
Genetic testing	None			
Immunization status	Up to date			
Vaccination history	None			
Travel history	None			
Exposure to pollutants	None			
Occupational hazards	None			
Work environment	Safe			
Job satisfaction	High			
Work-life balance	Good			
Financial stability	Stable			
Health insurance	Yes			
Access to healthcare	Good			
Health literacy	High			
Health beliefs	Positive			
Health behaviors	Healthy			
Health outcomes	Good			

HERZ TECHNOLOGIES INCORPORATE
Mela Hurn

16 OCT 2002

Date _____